perature and $U = \int_0^T C_p a T$, where C_p is the atomic heat.

The fact that emerges most clearly from all the work done on this subject is that the atomic heats of similar substances may all be represented by the same function $f(\nu)$ of the atomic frequency ν. Therefore, if A is the same for isotopes, and this would seem to be the definition of the word, their atomic frequencies must be identical. But as ν is a function of the atomic weight and of the forces acting between the atoms, the latter must vary when the atomic weights are different. If the force of attraction between two atoms is $a\phi(r)$ and the repulsive force $b\psi(r)$, r being the distance, then at a sufficiently low temperature the quasi-elastic force holding an atom in position is $a = 2k(a\phi'(r) - b\psi'(r))$. The constant k represents the action of the surrounding atoms and depends only upon the type of space-lattice formed by the atoms. As the atomic frequency $\nu = \frac{1}{2\pi}\sqrt{\frac{a}{M}}$ is the same for all isotopes, $\frac{a\phi'(r) - b\psi'(r)}{M}$ must be identical, whatever the atomic weight M may be. As Prof. Soddy has shown that the atomic volume and consequently r is also constant, it follows that both a and b must be proportional to the atomic weight.

This conclusion might, perhaps, be tested by a measurement of the vapour pressure of the different sorts of lead. The latent heat of sublimation λ is proportional to $a\int_r^\infty \phi(r)dr - b\int_r^\infty \psi(r)dr$, that is to M, as r is the same in both cases. The well-known equation $\lambda = RT^2 \frac{dlnp}{dT}$, where p is the vapour pressure, leads to $e^{\frac{\lambda_1 - \lambda_2}{KT}}$ as the ratio of the vapour pressures, if the chemical constant is equal. This is of the order $e^{\frac{68}{T}}$ if M varies by 0·26 per cent, *i.e.* about 20 per cent. at 100° C. The vapour pressure of radium D the atomic weight of which is 210 should be about $e^{\frac{360}{T}}$ times less than that of ordinary lead, that is, 2·6 times less at 100° C.

Another posible test would be to measure the melting point. In a great many cases $\nu = \text{const.}\sqrt{\frac{T_m}{Mr^2}}$. As ν cannot vary, and as Prof. Soddy has shown that r is constant, the melting point T_m should be proportional to M. Thus, for instance, the melting point of Prof. Soddy's lead should be 1·54° higher than that of ordinary lead. In all probability the atomic weight of the final product of thorium is 208·4, in which case the difference in the melting point should be as much as 3·75°. These consequences are not necessary but, admitting the absolute chemical identity, highly probable. They include the assumption that the radii of the atoms are equal as well as their mean distance apart in the solid state. In any case, a measurement would seem well worth while, as a negative result would be of almost as great interest as if a difference were observed. Unfortunately, the elastic constants which should vary by a corresponding amount can scarcely be measured with sufficient accuracy.

The following conclusions about the structure of the atom would seem to result. The purely chemical properties are determined by the external electrons which probably also account for the apparent radius of the atom. The forces of attraction and repulsion between the atoms, the interaction of which results in the solid state, have their origin in the nucleus. In isotopes they are proportional to the atomic weight, *i.e.* probably to the number of positive particles. They cannot, however, be considered simply as the sum of the forces between the positive particles, as they are additive only in isotopes, that is, when the charge on the nucleus is equal. The simplest assumption, therefore, would appear to be that the nuclei of isotopes differ in their linear dimensions, but not at all, or only very little, in the arrangement of the particles.

F. A. LINDEMANN.

Sidholme, Sidmouth, February 10.

The Green Flash.

PROF. PORTER's explanation of the green flash (NATURE, February 18) is unable to account for its appearance at sunrise, when it can be observed with great brilliance. When I was passing through the Indian Ocean on my way to observe the total eclipse of 1875 I happened to be on deck before sunrise one morning, and, watching for the first ray of the sun, was surprised to see the first flash of light appear as a vivid green. I had never heard of the phenomenon before, but atmospheric dispersion seemed to me sufficient to account for it, and I took it for granted that it was a well-known occurrence. I continued to observe the same effect several mornings in succession.

Since then I have undertaken many sea journeys, and though I do not recollect having ever again observed the flash or tried to observe it at sunrise, I have never lost an opportunity of watching for it at sunset. My experience does not support Prof. Porter's explanation, because the redder the sun at sunset, the less likely is the green flash to appear. The atmospheric conditions must be such that there is as little absorption as possible of the more refrangible part of the spectrum.

Those who want to see the appearance at its best should keep one eye closed as long as possible, and when the sun is just about to disappear, shut the eye which has been watching the setting sun, and open the other, which is then unaffected by the troublesome after-images which are otherwise seen. It is, of course, impossible to open the eye just at the critical moment, so that this alone is not sufficient to disprove Prof. Porter's explanation.

ARTHUR SCHUSTER.

Yeldall, Twyford, Berks., February 21.

Hormones and Heredity.

THE reviewer of Mr. H. Elliot's translation of Lamarck's "Philosophie Zoologique" in NATURE of February 11 remarks: "Unless we have misunderstood, a similar suggestion was made by Mr. J. T. Cunningham in 1908." The word "similar" refers to an alleged suggestion by Prof. MacBride that hormones may afford a clue to a possible *modus operandi* of the transmission of modifications. I should be glad to know when and where Prof. MacBride's suggestion was published, as I have not heard of it before. It would seem from the terms of this review that neither Mr. H. Elliot nor J. A. T. are fully acquainted with my paper on the heredity of secondary sexual characters in relation to hormones, published in the *Archiv für Entwicklungsmechanik* in 1908. The hormone theory of heredity is elaborated in considerable detail in my paper. I do not think it is possible to misunderstand it, and it is much more than a "suggestion."

J. T. CUNNINGHAM.

S.W. Polytechnic, Chelsea, February 15.

IT seemed to me that there was some historical interest in recalling Mr. Cunningham's paper of 1908.

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As I was unable at the time to refresh my memory on the subject, I wrote guardedly, "Unless we have misunderstood." A fitter expression would have been, "If we remember aright." It is satisfactory to know that my recollection was substantially correct. To object to the theory being called a "suggestion" seems fastidious. As to Prof. MacBride's suggestion, Mr. Elliot's reference was to a proof of vol. i. of "A Treatise on Embryology." J. A. T.

THE NATURAL HISTORY BUILDING OF THE UNITED STATES NATIONAL MUSEUM.[1]

MR. RATHBUN has done well to publish a full technical account of this building, which claims "to be greatly in advance of all other museum buildings intended for a similar purpose." The three objects aimed at have been storage, usable exhibition space, and laboratory accommodation. The epithet "usable" is important, for in exhibition galleries dark corners and obtrusive architectural details are worse than useless. "Usable" also implies facility of accommodation to growing and changing needs. With this in view, the building has been planned as a great shell, with few permanent division walls; and, by giving exceptional width to the main mass, the floor area is large in proportion to the extent of outer wall. The plan, which covers nearly four acres, shows a large pavilion surmounted by a rotunda facing south, and from it three wings extending towards the east, west, and north; the latter are connected near their outer ends by two L-shaped ranges, completing the enclosure of two large uncovered courts.

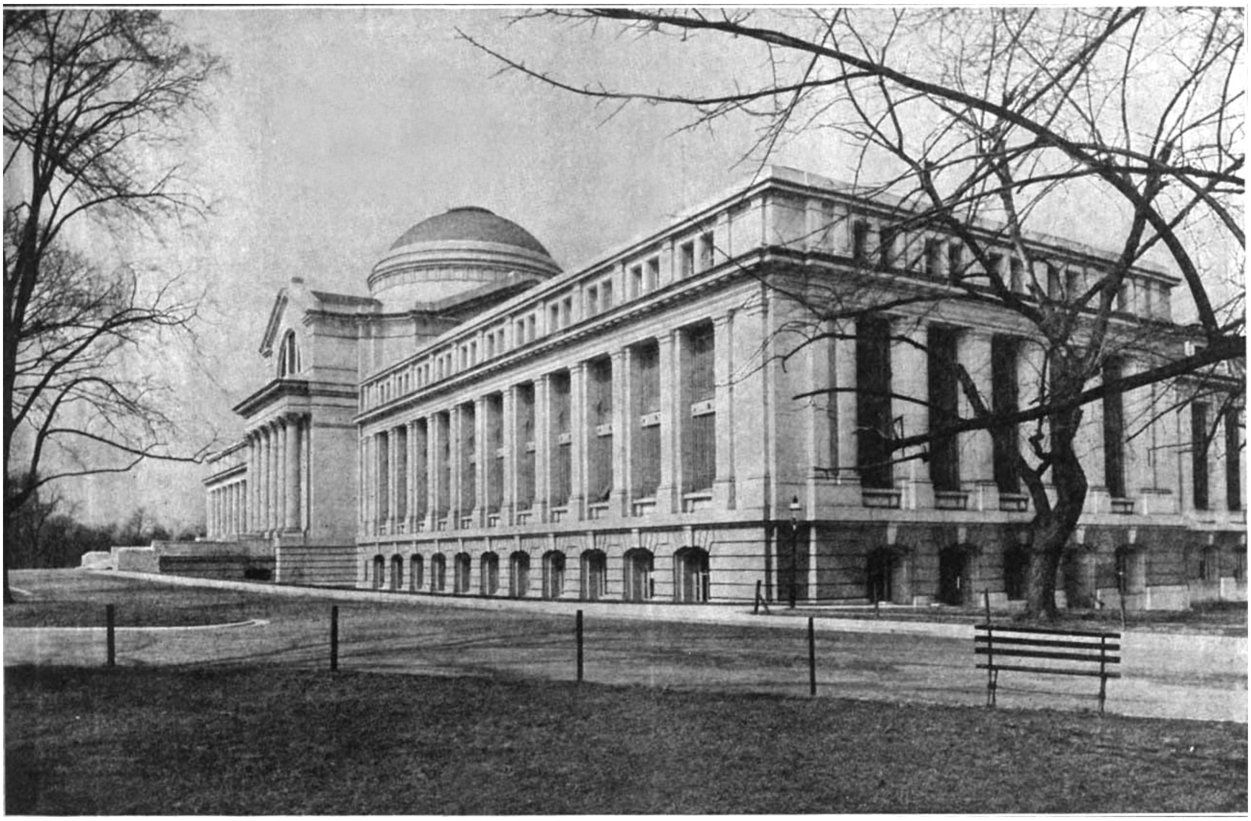

FIG. 1.—United States National Museum, Natural History Building, viewed from S.E., showing the South front, the outer end of the East wing, and the beginning of the East range.

The length of the southern façade, shown in perspective in our Fig. 1, is 561 ft.; the greatest north and south measurement, which is along the middle block, is about 364 ft.; each court is 128 ft. square. The wings have a width of 116 ft.; and the L-shaped ranges a width of 61 ft. This great width and the fact that the building is four storeys high might lead one to expect a deficiency of light. The modern classic style, however, has permitted exceptionally large windows (Fig. 1) in all but the upper storey, where, of course, skylights are available. Moreover, in these windows a maximum of glass surface has been secured by the use of light metal framing. Light is also furnished to the wings by light-wells 50 ft. wide, which break through the upper storeys and light all except the basement or ground storey. The floor of the first storey is thus all available, but the top-lit area is usually separated by glazed

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[1] "A Descriptive Account of the Building recently Erected for the Departments of Natural History of the United States National Museum." By Richard Rathbun. U.S. National Museum, Bull. 80. Pp. 132+xxxiv plates. (Washington, 1913.)

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